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RECYCLING OF SUSTAINABLE SYSTEMS AND SUBSTRATES AND ITS ENERGETIC USE IN REMOTE
ZONES (VASSSUREN)

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Abstract

This work deals with the development of innovative solutions to cover the energy supply in remote and depressed zones. The cost of so-called “green” energy is being reduced as its efficiency is increasing day by day, both in the electric generation through photovoltaics, wind energy or fuel cells.

The aim of this work is to study, design, develop and evaluate a new integrated and self-sustained energy system, able to supply the basic electric energy to a remote and local agricultural plant. It will be integrated by photovoltaic devices used to electrically feed an electrolyzer, able to obtain hydrogen from organic residues, the storage of this hydrogen will be done under pressurized tanks or by physical adsorption onto different substrates. This hydrogen will be used in a Proton Exchange Membrane Fuel Cell (PEMFC) with a power density of 5-10kW, in order to provide electricity to a local agricultural self-sustainable plant.

This proposal deals also with the viability of the use of residues from the local socioeconomic base as the raw material in the electrolyzer for the hydrogen production. Therefore, generating a self-sustaining energetic system suitable for backwoods and remote areas of undeveloped countries.

Keywords: *Energy, integrated, self-sustained, Fuel Cells, Electrolysis, Solar Cells*

INTRODUCTION

The present idea is the core of a proposal presented to the last call of CYTED, which is a programme for the science and technology development of latinamerican countries which activities are focused in the promotion of the cooperation between these Ibero-American countries, in this case to contribute to its sustainable development.

With this aim, the cooperation of different energy systems and its assembly in an single energetic supplier self-sustainable could be the answer to those remote poblations placed away the conventional energy sources, and in addition could be the begining of a new energetic schedule for those places which are still under development.

The center of this proposal involves the use of subproducts both from the industry or the human activity, oftenly contaminants, as a substrate and a precursor of hydrogen, electrochemically produced in a reactor/electrolyzer. This electrolyzer has been developed in the framework of a R&D project supported by the CSIC (PIE, 2004 8 0E 254), under this work it has been previously demonstrated that pure hydrogen can be produced from a polysaccharide/water mixture. Moreover, the production of hydrogen from other organic molecules has been assesed. Actually, one of the challenge of this proposal is the generation of hydrogen from the residues produced from the local industry by assisted electrolysis. This electrolyzer will be feed by solar energy provided, in a first approach, by a commercial solar cell made based on silicon. The hydrogen generated will be use in a PEMFC stack (5-10kW) made in CSIC. The components of this stack will be in a first moment commercial, Pt/C and PtRu/C electrocatalysts and Nafion® membranes. Although in parallel a smallest stack will be assembled with alternative components (CSIC technology) to study the viability of this

The obtained hydrogen will be storage using two methods, under pressure, as it is conventionally done and using the physical adsorption method onto organo-complexes. The excedent energy will be storage in a commercial lithium battery.

EXPERIMENTAL

The specific objectives of this proposal are:

1. Assembly of Photovoltaic comercial Solar Cells supplied by CSIC (150 W). Development of new nanostructured photoelectrochemical solar cells based on the achievement of ceramic interphases of active oxides. This solar cells should exhibit similar electric yields than the conventional based on Si, although the requested power is 5 W.

2. Hydrogen production by assisted electrolysis, the reactor/electrolyzer is already developed. Evaluation of the viability in the use of residues for hydrogen production. The recycling of the residues produced in the agricultural plant that will be powered by the PEMFC, this consists of a small and local milk production. The residues are based on a lacto-serum, with a high content in polysaccharides which is considered a sub-product of the whole process and thus it is thrown away. The yield of the electrochemical reaction will be studied as well as the purity of the hydrogen produced.

3. Hydrogen storage will be carried out by physical adsorption in nanoporous 3D molecular scaffolds formed by polymers with metallic centers distributed along its surface. This scaffolds will be prepared by the co-precipitation of polymers and metal solutions and also by hidrothermal synthesis.

4. Desing, development and construction of a PEMFC stack (5kW) that will supply the power to the plant. The assemblies will be prepared from commercial components, the homogeneity will be ensured by the method used for the catalytic layer preparation which has been patented (Nº 200202876). The stack assembly will be that using the corrugated bipolar plates also designed by CSIC. The stack will be evaluated by means of two parameters, the power density demanded and the life time of the cell. The excess in the power density generated will be storage by comercial lithium batteries (50W).

5. Integration of all the systems metioned as it is shown in figure 1. The production costs will be determined and compared with the conventional

energy sources. The total energy will also power a small communication device.

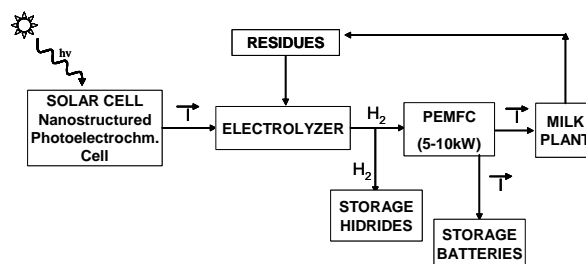


Figure 1. Integrated energetic system

RESULTS AND DISCUSSION

The aim of this proposal is the rational use of technology applied to the energy area, with this concern, the development of different components with new materials, increasing the electrochemical yields and decreasing the production costs, specially dealing with PEMFC technology, and in solar cells (currently under a high development). Therefore, the goal of this project is to decrease the cost of this technology, trying to make it globally accesible. In a first approach all the components involved are based on commercial products, which have been already optimized by the groups involved, however the final aim is to substitute the commercial materials by the ones developed in the framework of the project, seaching for a low cost, simplification and long life in operation. For this reason, this proposal is related with other national and international R&D projects.

CONCLUSIONS

An integrated energy system based on renewable, clean and the recyng of residues is proposed as an alternative to conventional energy sources, for those remotes areas which are under development.

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